



Investigation of probable fluid pathways in NW Bohemia/Vogtland (German-Czech border region)

Sima MOUSAVI¹, Klaus BAUER², Sigward FUNKE¹, Michael KORN¹, Christoph SENS-
SCHÖNFELDER²

3-D V_p and V_p/V_s structure of the geodynamically active NW Bohemia/Vogtland area, located at the border region between Germany and Czech republic, has been determined from local earthquake tomography using 543 earthquakes which have been recorded during 2000 to 2010. This region is known for the occurrence of earthquake swarms that are supposed to be triggered by fluid up-welling in the crust, although fluid behavior and migration paths in the subsurface of NW Bohemia is still poorly known. The events used in this study were selected based on a minimum 12 P and S phase observations and an azimuthal gap less than 170° . This data set is employed to derive a minimum 1-D velocity model (Fig. 1) and to relocate the hypocenters. The minimum 1-D velocity model is then used as an initial model in non-linear inversion to derive 3-D P-velocity and V_p/V_s ratio. Using synthetic tests, it can be shown that a high resolution is obtained in the central part of the studied region with the given source and receiver configuration.

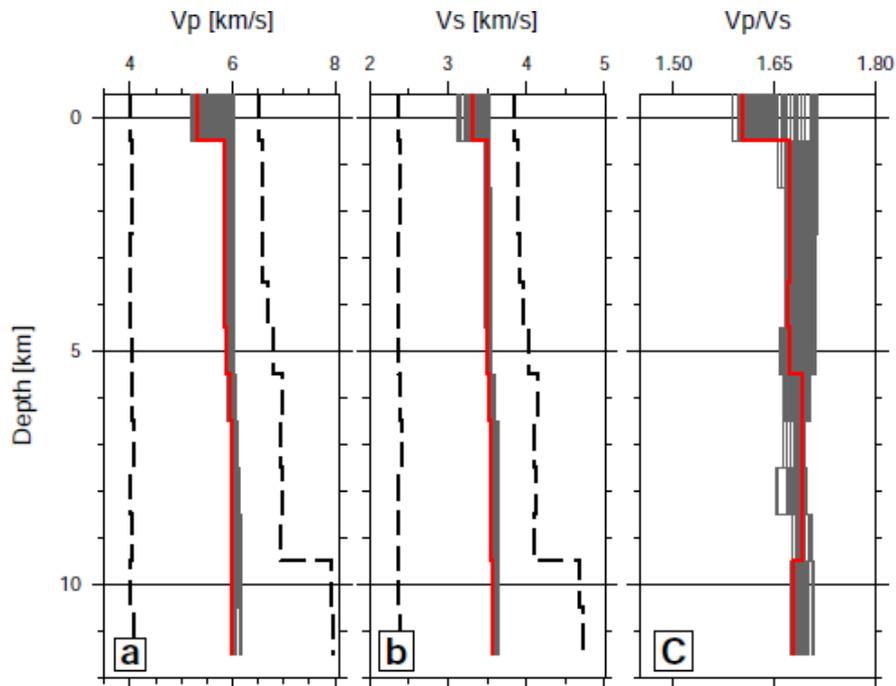


Fig 1. a) minimum 1-D velocity model for V_p , b) V_s and c) V_p/V_s ratio as function of depth. In a,b) Black dash are limits of input random models and grey lines represent final converged models. Red line is the final minimum RMS model with smallest RMS value among converged models.

¹Institut für Geophysik und Geologie, Universität Leipzig, Talstraße 25, 04103 Leipzig, Germany

²Deutsches Geoforschungszentrum Helmholtz-Zentrum Potsdam, Germany

The main focal zone that released more than 90 percent of the seismic energy since 1985 is located in NW-Bohemia at the Marianske Lazne fault zone. The active volume is only about $1 \times 1 \times 1 \text{ km}^3$. According to the tomographic results the hypocenters are within a low V_p and V_p/V_s anomaly. Two branches of high V_p/V_s ratio anomalies have been detected above the focal zone (Fig. 2), which could be indication of admixing supercritical fluids with crustal fluids. These anomalies support the existence of two main fluid passages toward Bad Brambach (in the distance of 10 km from Novy Kostel toward west) and Bublak moffette (above swarm area).

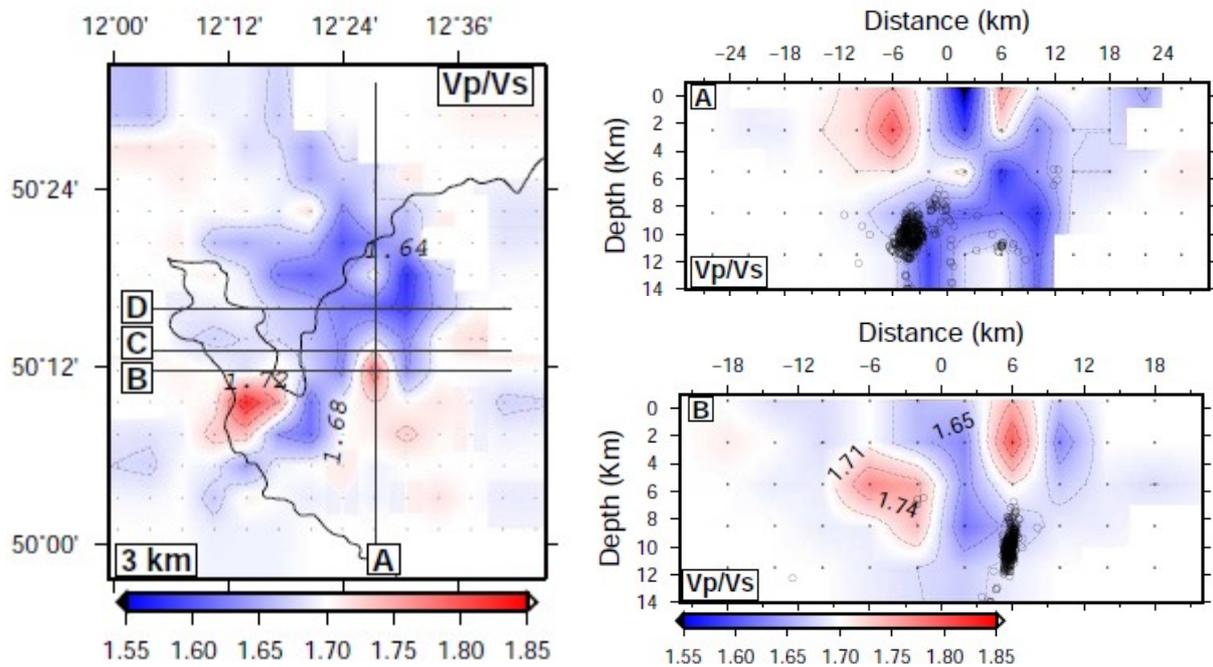


Fig. 2. Horizontal slice of the model at depth of 3 km for V_p/V_s and its vertical structure along the cross-sections A and B down to depth of 14 Km.

In the Bublak area there is constant degassing of CO_2 at the surface. Some km N of Bad Brambach we could detect and precisely located a microswarm of 120 events with magnitude up to 1.9 in 2010 that occurred along a sub-vertical line at depths from 11 to 8.8 km in a strictly ascending order (Fig. 3). Close to the epicentres a blow-out of CO_2 from a depth of about 500 m happened during drilling in 2013.

The correlation between earthquake hypocenters, V_p and V_p/V_s anomalies and CO_2 degassing suggests a model in which CO_2 as part of magmatic fluids exists in a vast area beneath NW Bohemia and frequently migrates up to the surface.

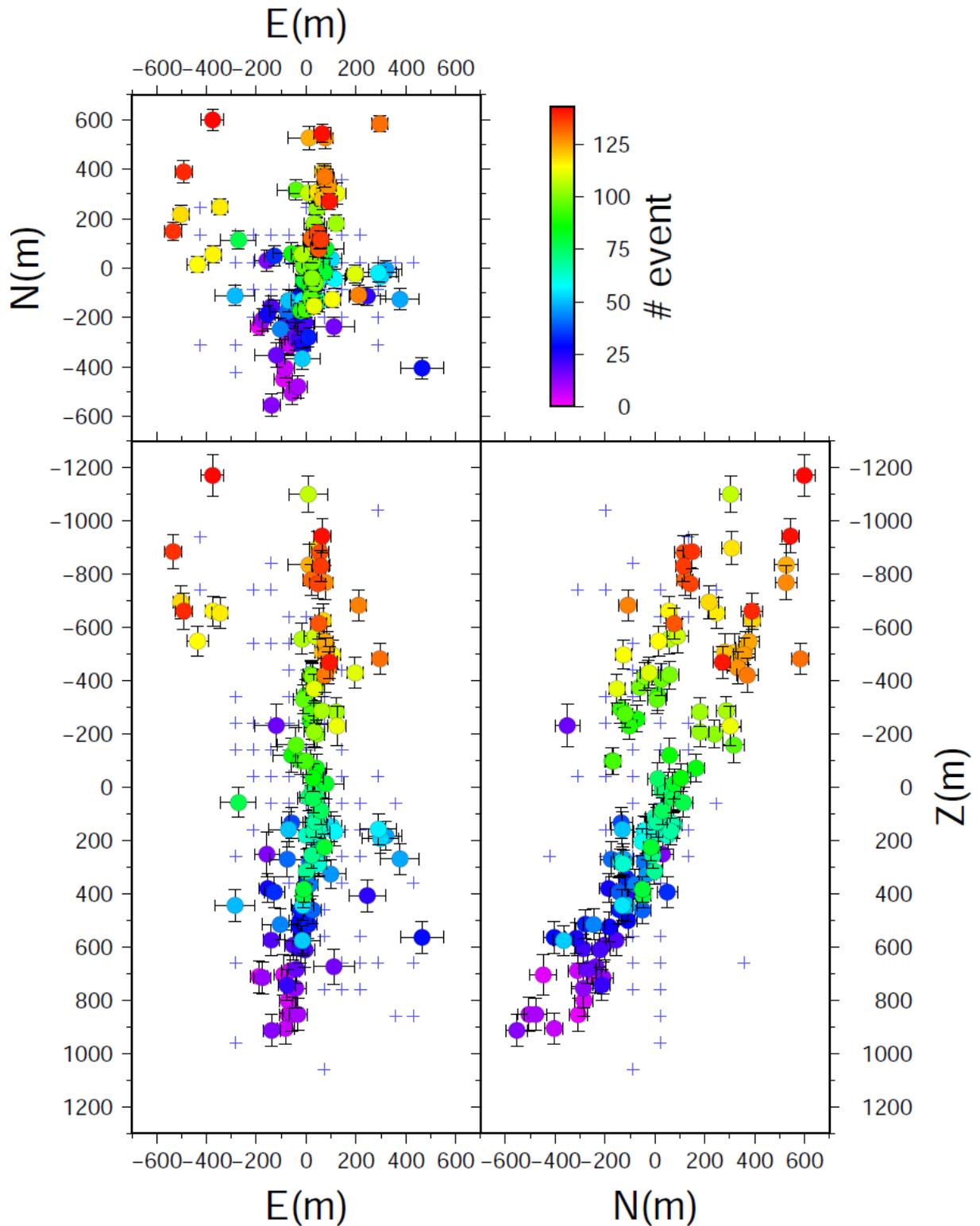


Fig. 3. Location results, foci: Top: map view, centered at 50.265°N , 12.300°E ; Bottom left: W-E section, depth centered at 9.94 km ; Bottom right: S-N section; Light blue crosses: routine localization without error bars; Colored circles: relocation with error bars, number of events colored by timeline.